Northern Michigan University

Wireless Network & Broadcast Technology

Michigan House of Representatives
Energy and Technology Committee
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Community Profile

- Rural mining/Logging/tourist blue collar community
- Limited communications infrastructure/broadband availability
- Median household income in Marquette County for 2004 (based on U.S. Census data) was $38,419 (lower than U.S. average)
- Small city (22,000) in the midst of undeveloped wilderness
- Largest community in 150-mile radius

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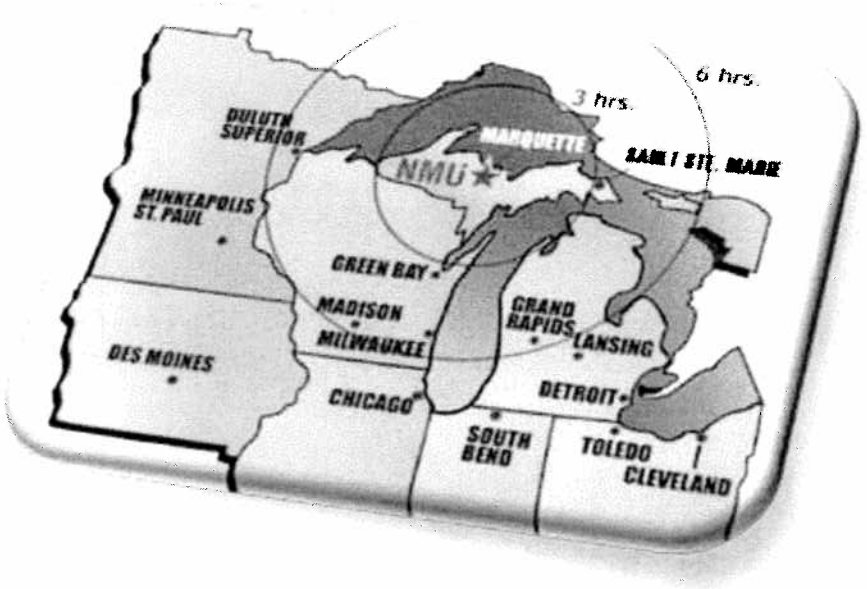
University Profile

- NMU is a comprehensive, masters-level university.
- Offers 180 programs emphasizing technology. Largest are:
  - Nursing
  - Teacher Education
  - Art & Design
  - Business/Computer Information Systems
- Currently:
  - 9,500 undergraduate/graduate students with over 1,100 faculty/staff.
  - Over 1,600 hybrid and web-based on-line courses.
  - 6,000+ students live off campus.
  - 82% of NMU students receive financial aid
  - Need-based: 35% – 40% are Pell eligible
  - <u>All</u> University teaching, learning, and business services <u>require</u> access to broadband communications.



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Technology Goals

Access

- Provide access to teaching, learning, and communication anytime, anyplace.
- Ensure equal student access to mobile computing and communication technology.

Support services

- Deliver high quality, timely computing and academic support services.

Technology Goals *(continued)*

Cost

- Provide affordable computing through leveraged support, acquisition and deployment costs.

Standardization

- Facilitate learning through the use of integrated technology
- Deliver high quality support
- Quicker, easier adaptation of new technology including:
  - ✓ Next generation wireless networking
  - ✓ New software
  - ✓ Mobile hardware

Technology Goals *(continued)*

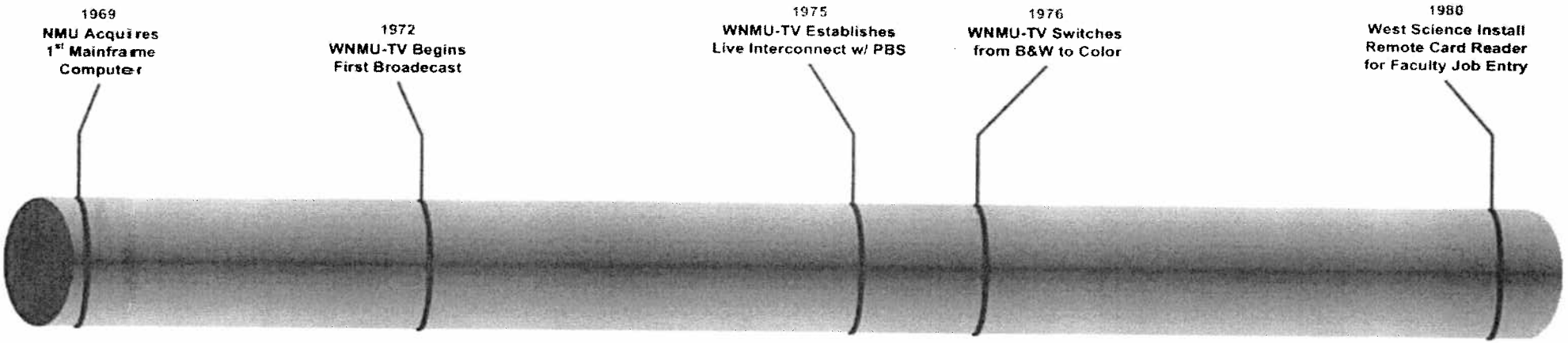
K-16 Partnerships

- Develop of new initiatives that enhance and expand service to teachers and students in public education.

Economic Development

- Refine and enhance local township and city government services that attract new business and improve services to residents at lower cost.

NMU Technology – 1970's



1970

1980

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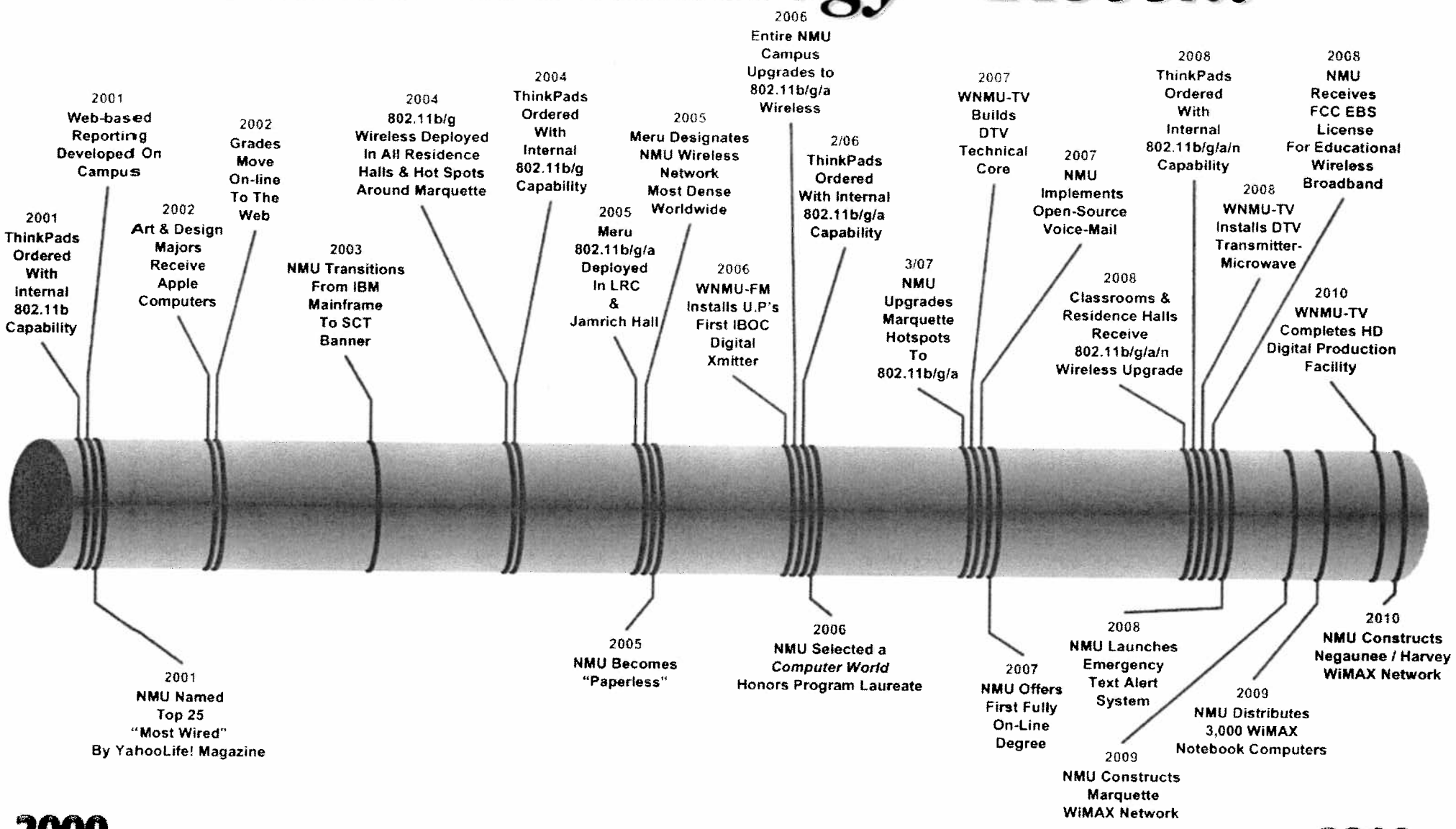
NMU Technology - Recent



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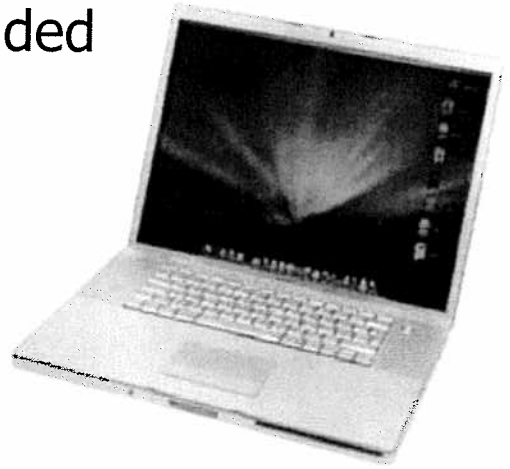
Technology Summary

- ✓ All faculty and students equipped with notebook computers
- ✓ Software included
- ✓ Repairs, maintenance, support & insurance included
- ✓ Gigabit hard-wire connections in all buildings
- ✓ Includes internet access
- ✓ Wireless throughout campus & community
- ✓ The majority of campus courses and business activities use web-based services

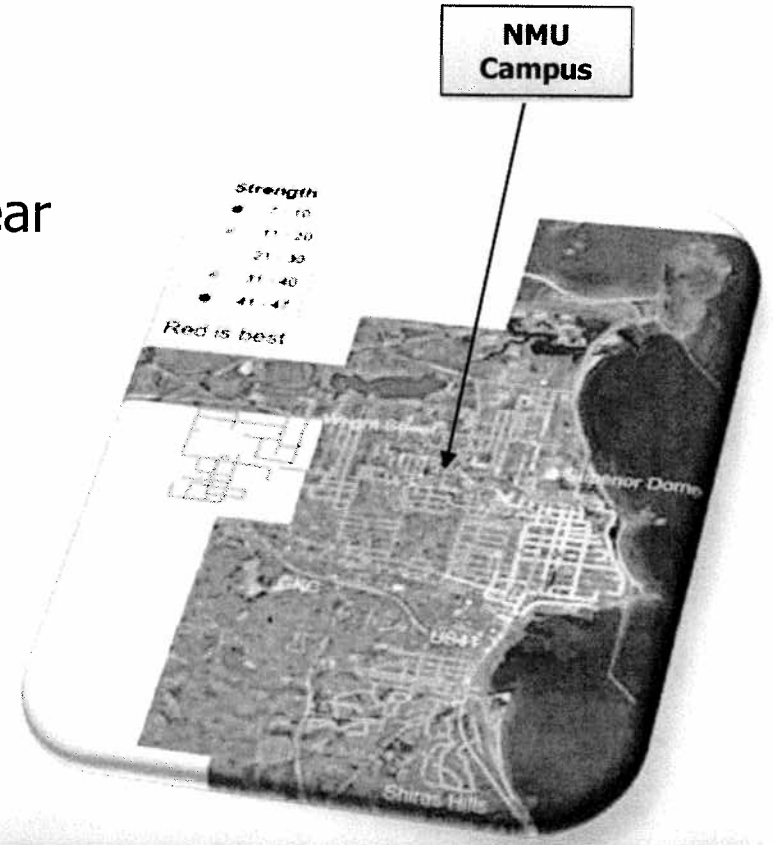


Experimental Community WiFi

In 2003, NMU experimented with off-campus community Wi-Fi network access to meet growing broadband needs

What We Learned:

- RF power and line-of-sight limits restrict students' ability to connect – even when near an access point
- Wi-Fi fails to provide adequate building penetration
- City-wide coverage not practical or cost effective
- Maintenance issues abound, especially in severe winter climates



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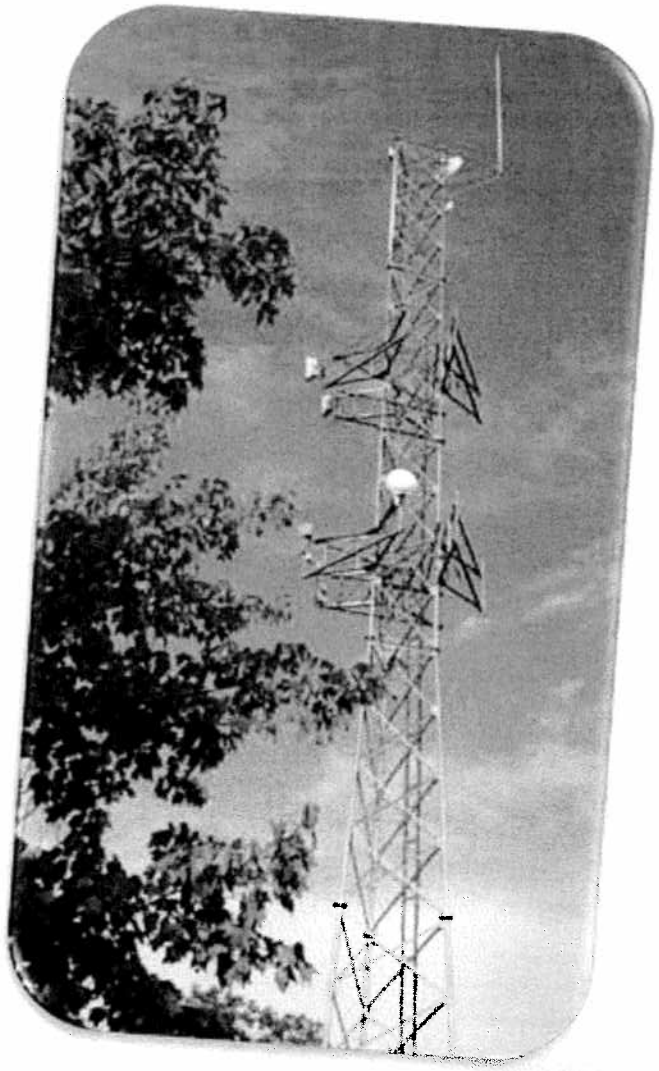
Wi-MAX Technology

A fourth generation (4G) wireless internet service that provides broadband connectivity to large numbers of network enabled clients.



Essential Components:

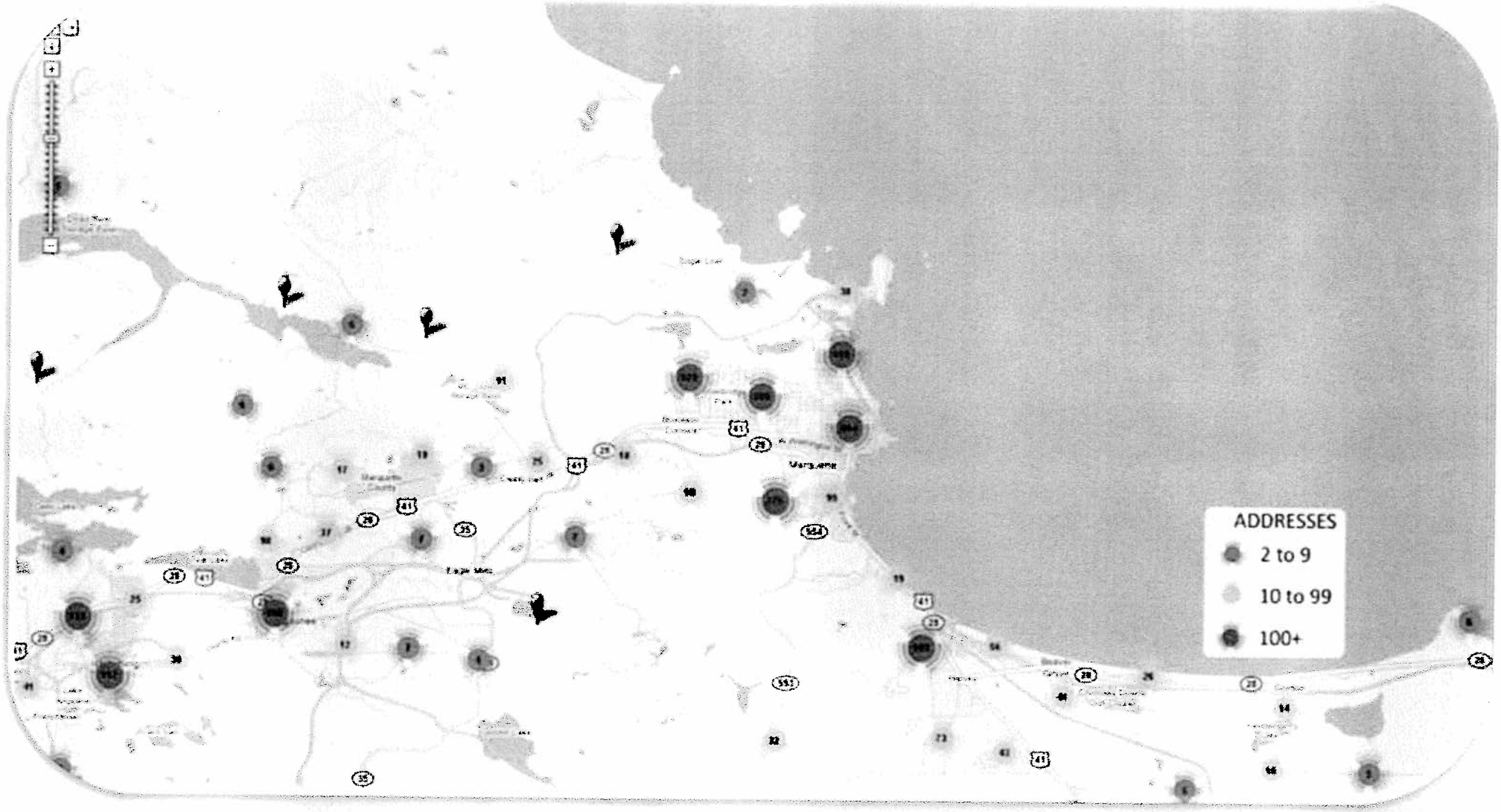
- Strategically placed transmitters on towers or high points within a community
- High-bandwidth back-haul service to enable internet access

WiMAX vs. Wi-Fi

- Coverage measured in miles
- FCC licensed with guaranteed interference protection
- 4th generation technology still in development
- Provides for excellent building penetration
- Carrier-grade service designed for large numbers of clients

- Coverage measured in feet
- Unlicensed service prone to interference
- Mature technology with little room for growth or enhancement
- Weak signals do not penetrate trees or structures well
- Access points quickly overwhelmed with multiple users

NMU Off-Campus "Heat Map"



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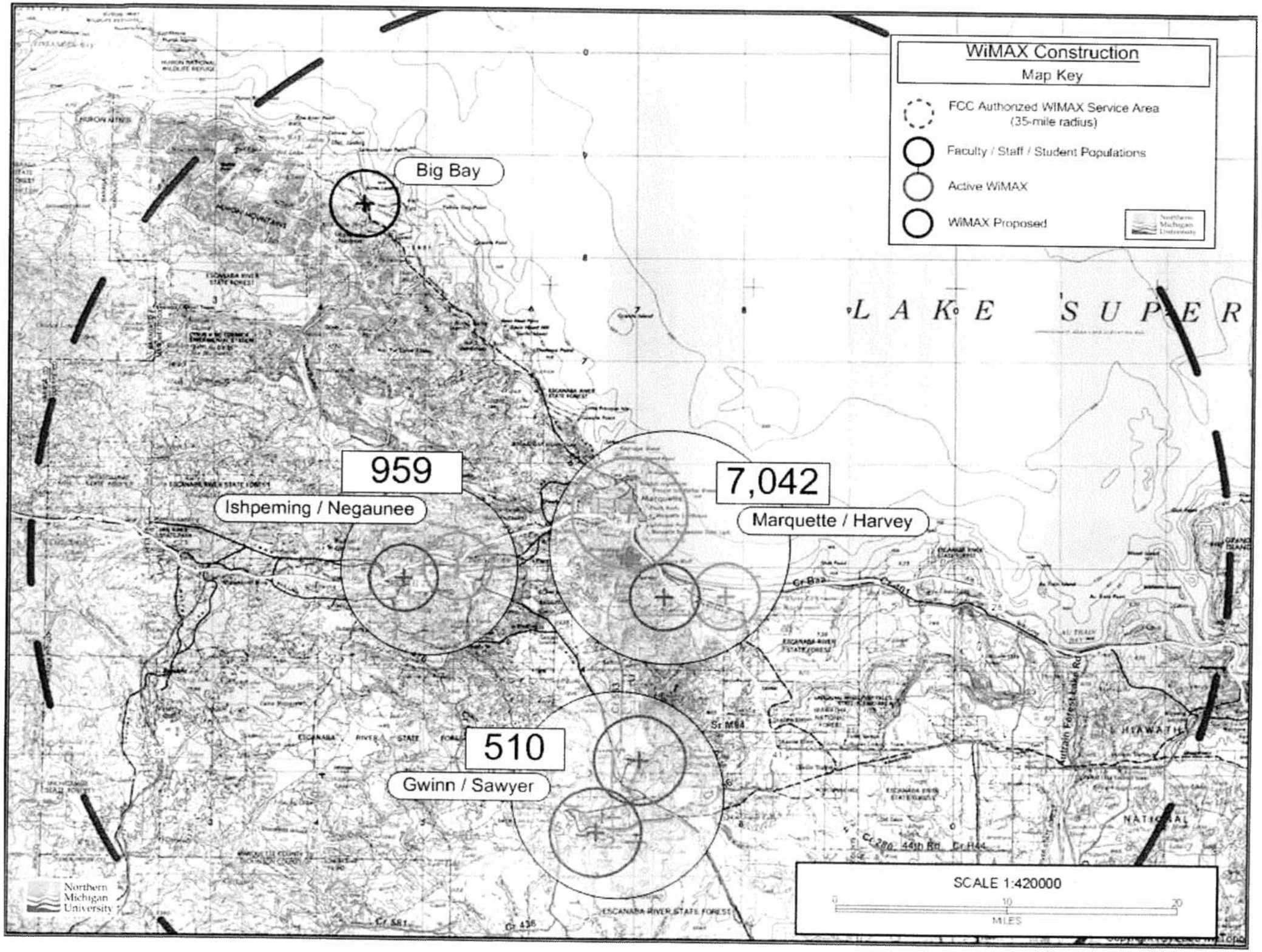
WiMAX Construction
Map Key
FCC Authorized WiMAX Service Area
(35-mile radius)
Faculty / Staff / Student Populations
Active WiMAX
WiMAX Proposed
Big Bay
959
Ishpeming / Negaunee
7,042
Marquette / Harvey
510
Gwinn / Sawyer
L A K E S U P E R
SCALE 1:420000
0
10
20
MILES
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Mqt Twp Fire Tower
Cohodas
Pine Ridge
Mountain Tank
Morgan Meadows
Mount Mesnard
Negaunee Water Tower
Range Tower Ishpeming
Cliffs C shaft
Golf Course
Sawyer Water Tower
Gwinn Water Tower
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Big Bay Demonstration Project

intel

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RESA Marquette-Alger Regional Educational Service Agency

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Big Bay Demonstration Project

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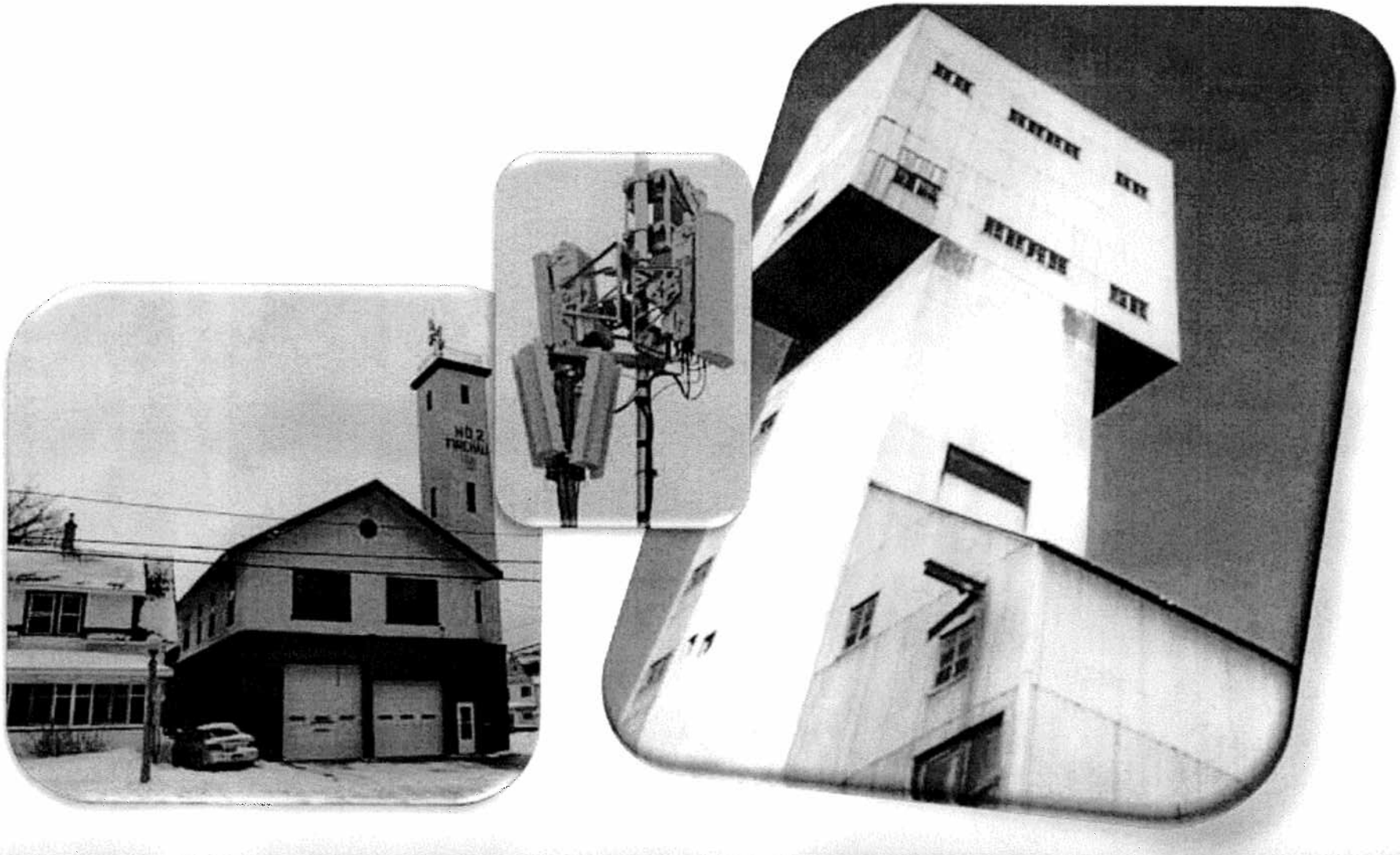
Community Partnerships



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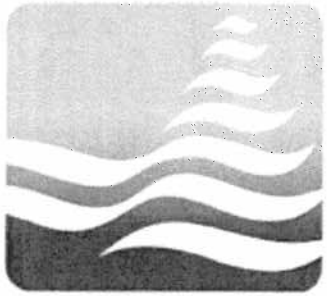
Public / Corporate Partnerships



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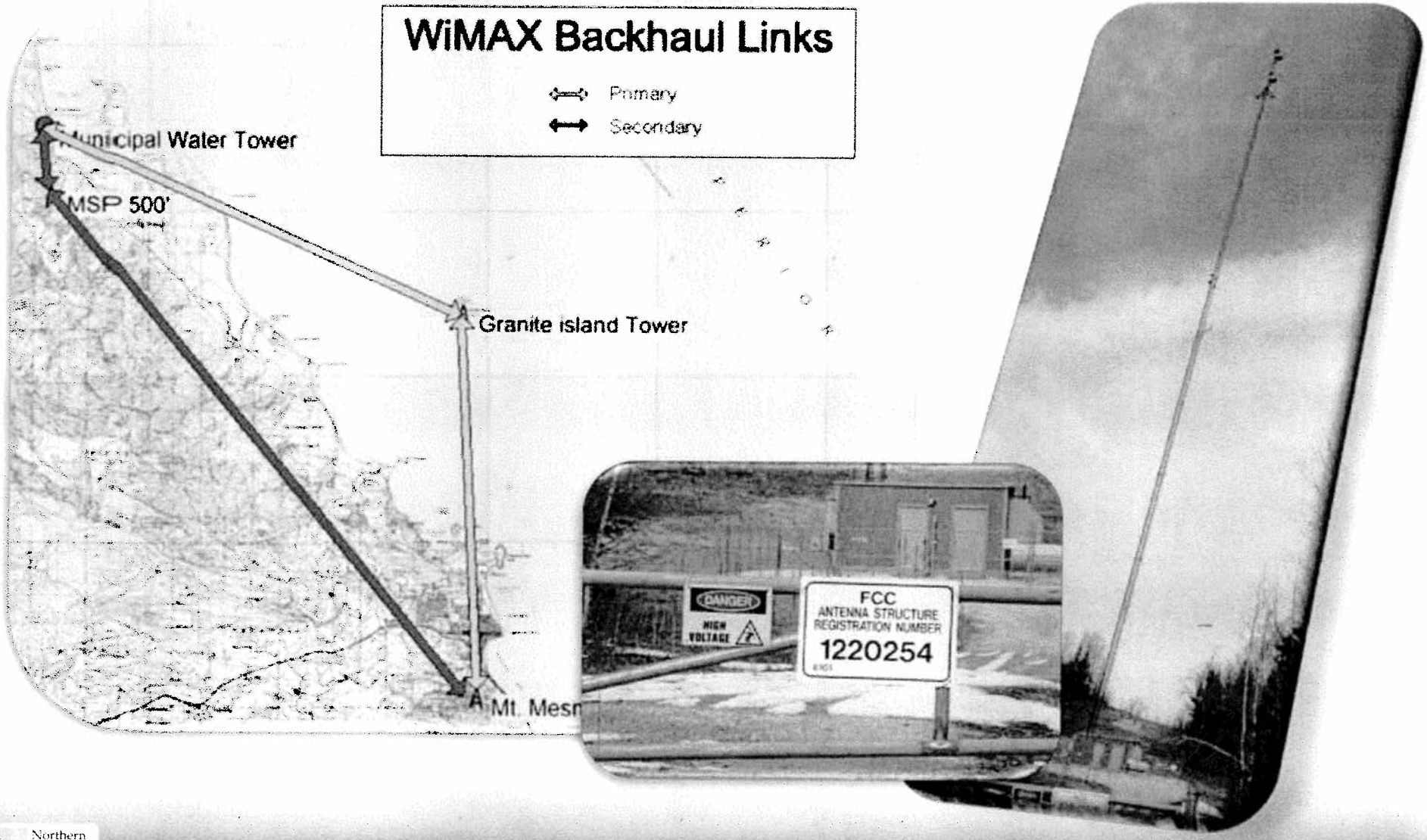
Critical Partnerships



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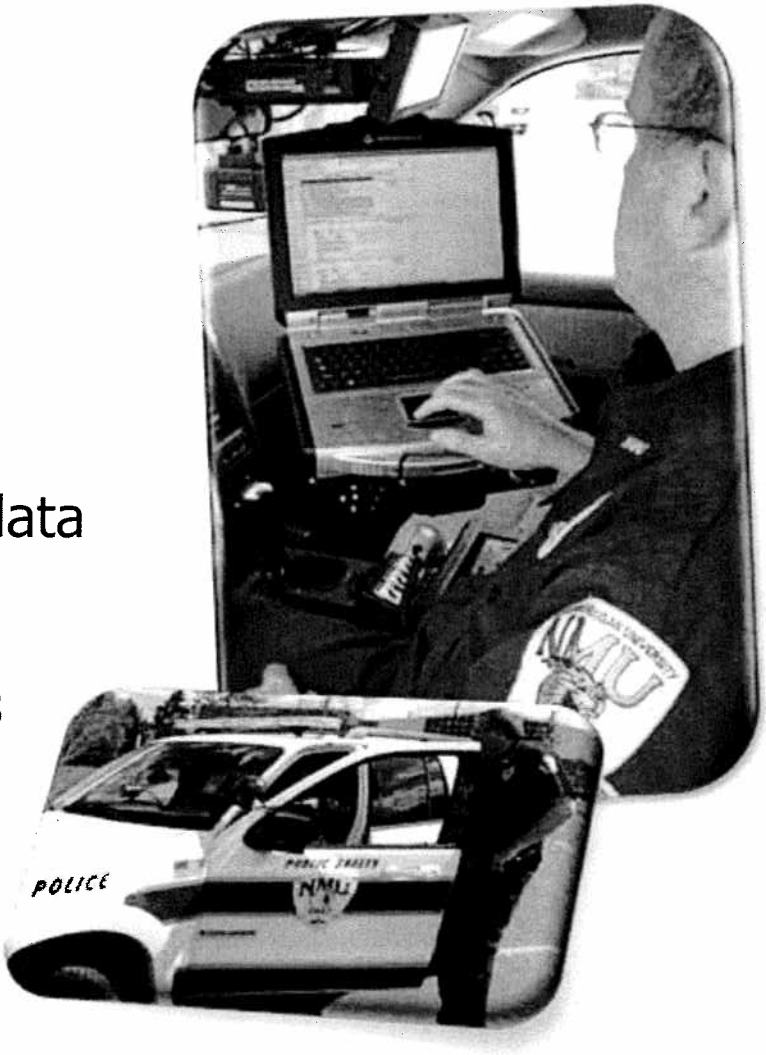
WiMAX Benefits

- ✓ Low cost LEIN access for law enforcement
- ✓ Network service to unserved city buildings
- ✓ Utility monitoring and remote control access
- ✓ Mobile GPS capabilities for city operations
- ✓ Emergency services access to maps, MSDS data and control systems
- ✓ Student home access to educational services
- ✓ Interactive multi-media access for education
- ✓ Middle college and dual enrollment access to area colleges and universities



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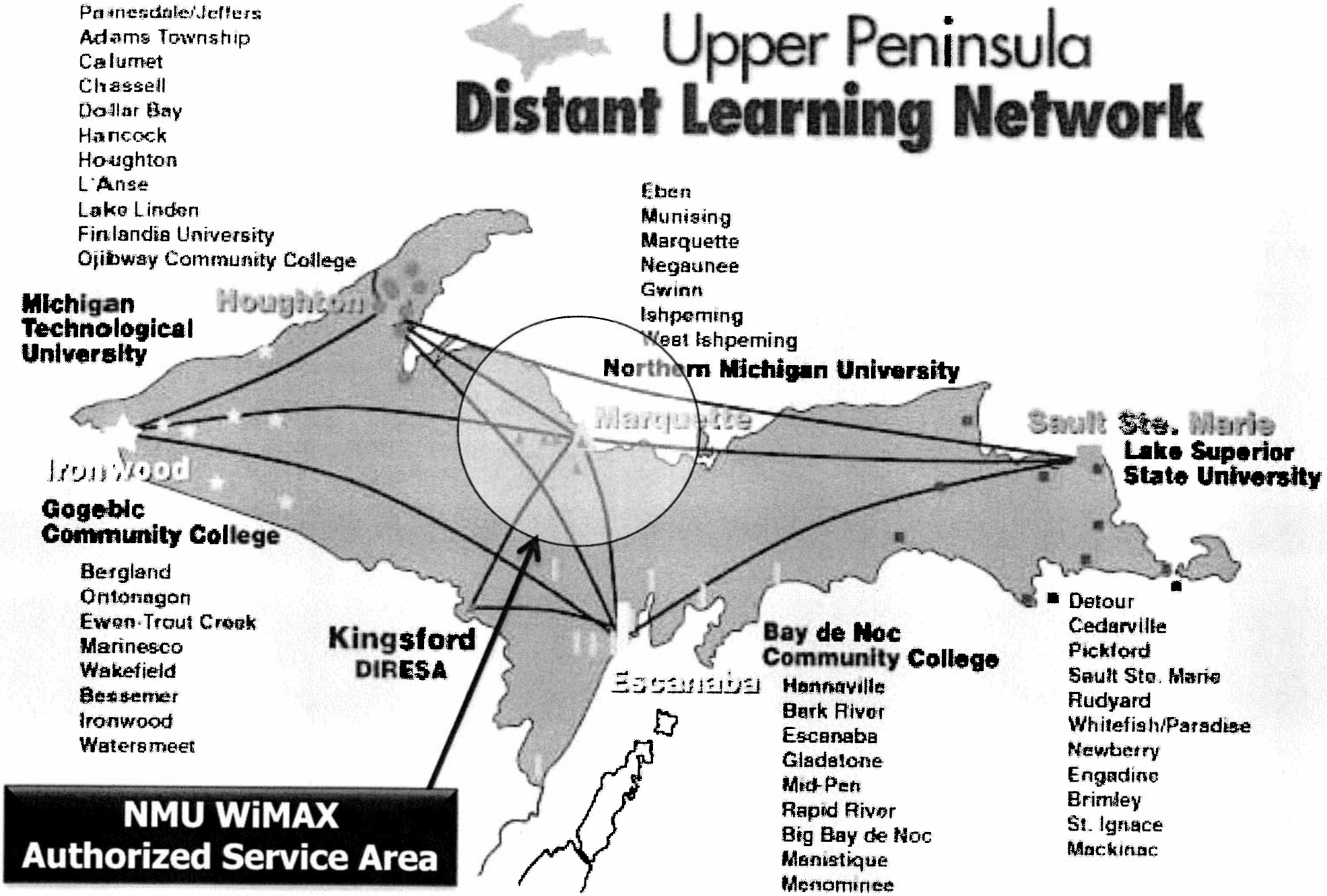
K-12 Connection

Assistance to public and charter schools in need of advanced broadband technology services

- New opportunities for advanced students in need of college courses while still in high school (dual-enrollment)
- Virtual field trips
- Access to career pathway presentations available from specialized industrial, health-care, education and government service providers
- Universal access to basic web-based school services such as student record databases, research content and testing services

Upper Peninsula
Distant Learning Network



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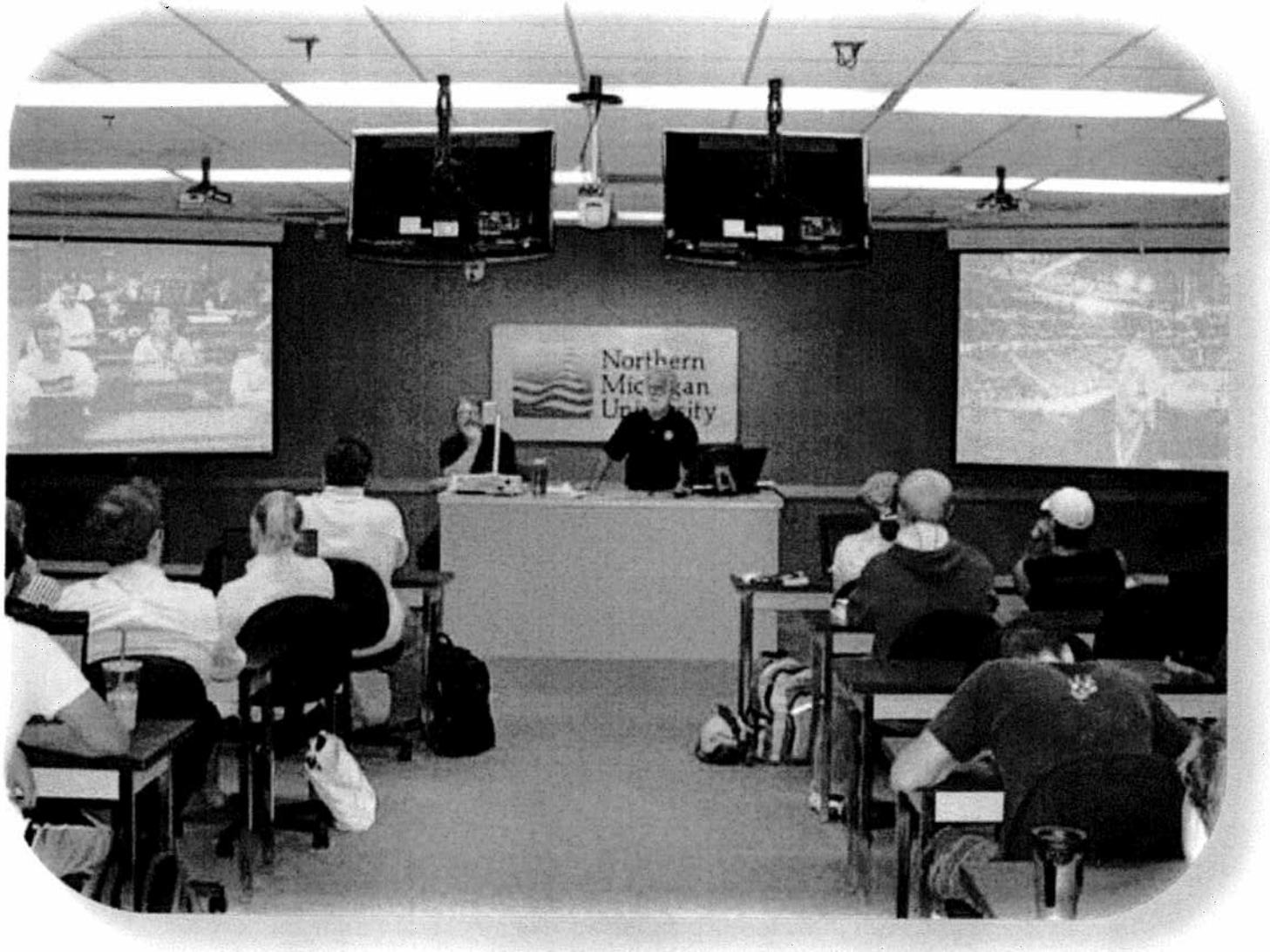
Mobile Computing & Instruction



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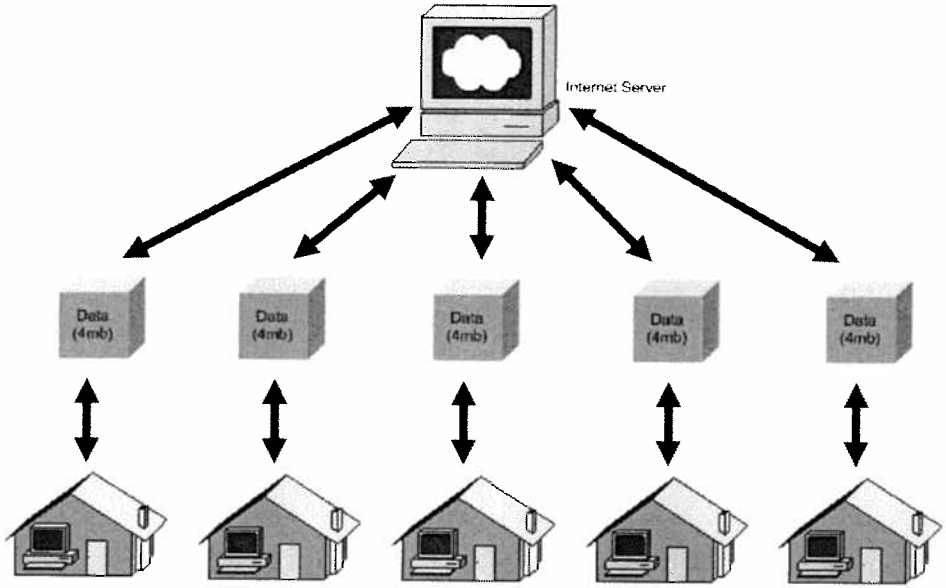
Internet vs. Broadcast

Internet

One to one relationship.

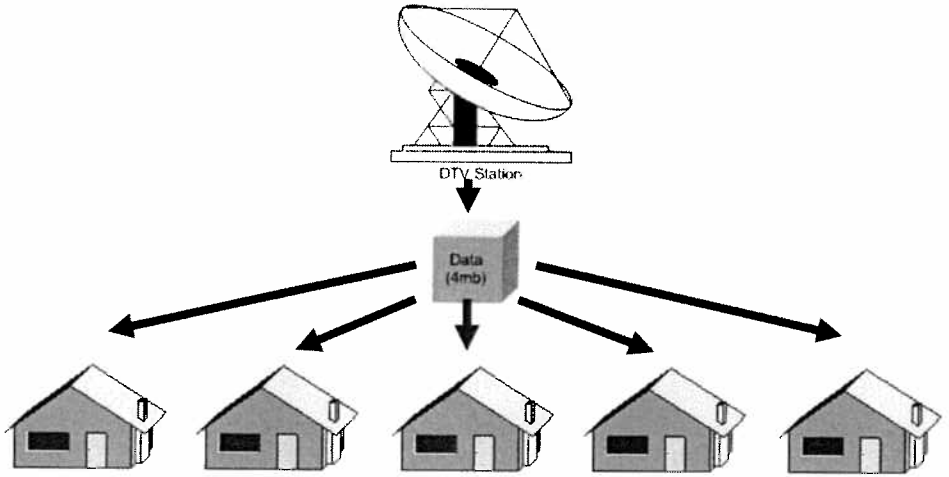
Each file request requires additional bandwidth

Viewers	Number of Files	Bandwidth Required
5	1	20mb
100,000	100,000	400,000mb
5	1	4mb
100,000	1	4mb



Digital Broadcasting

One to many relationship.
Each file request consumes no additional bandwidth



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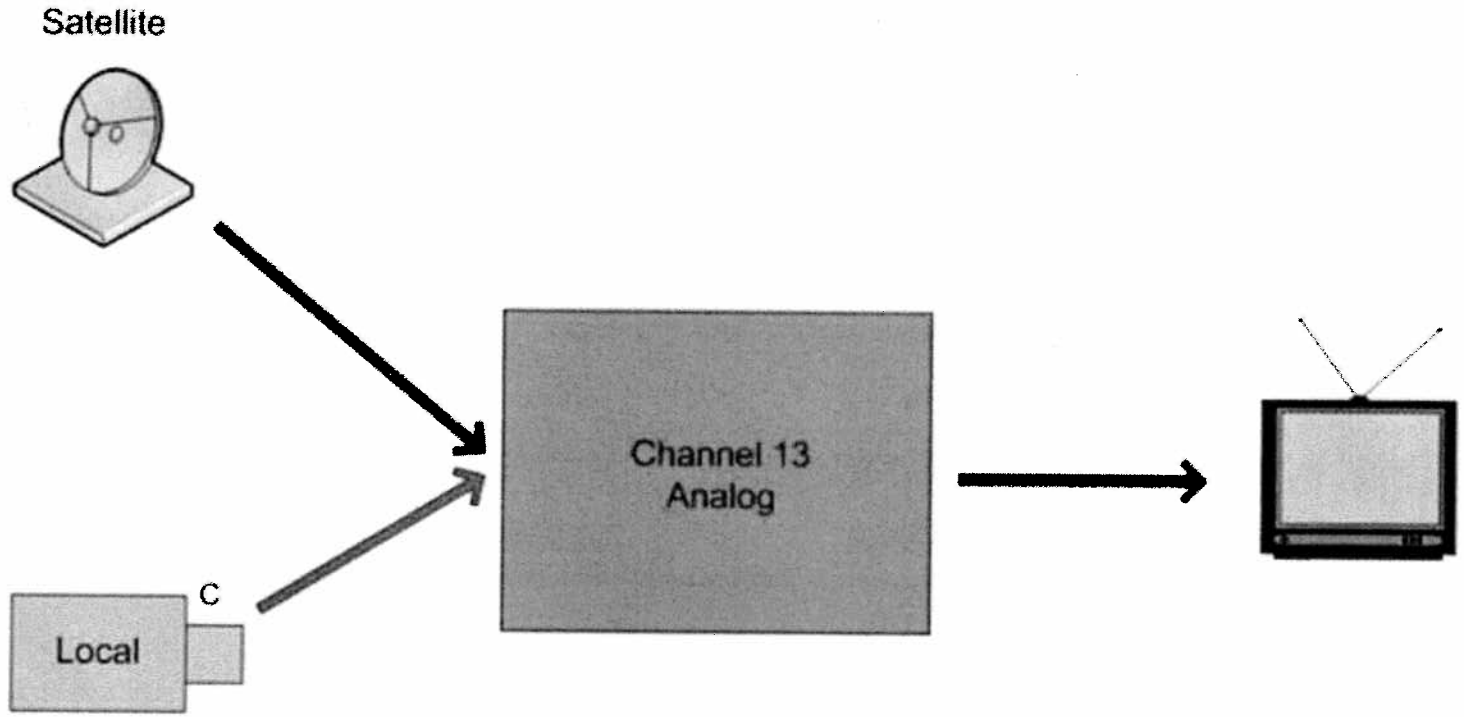
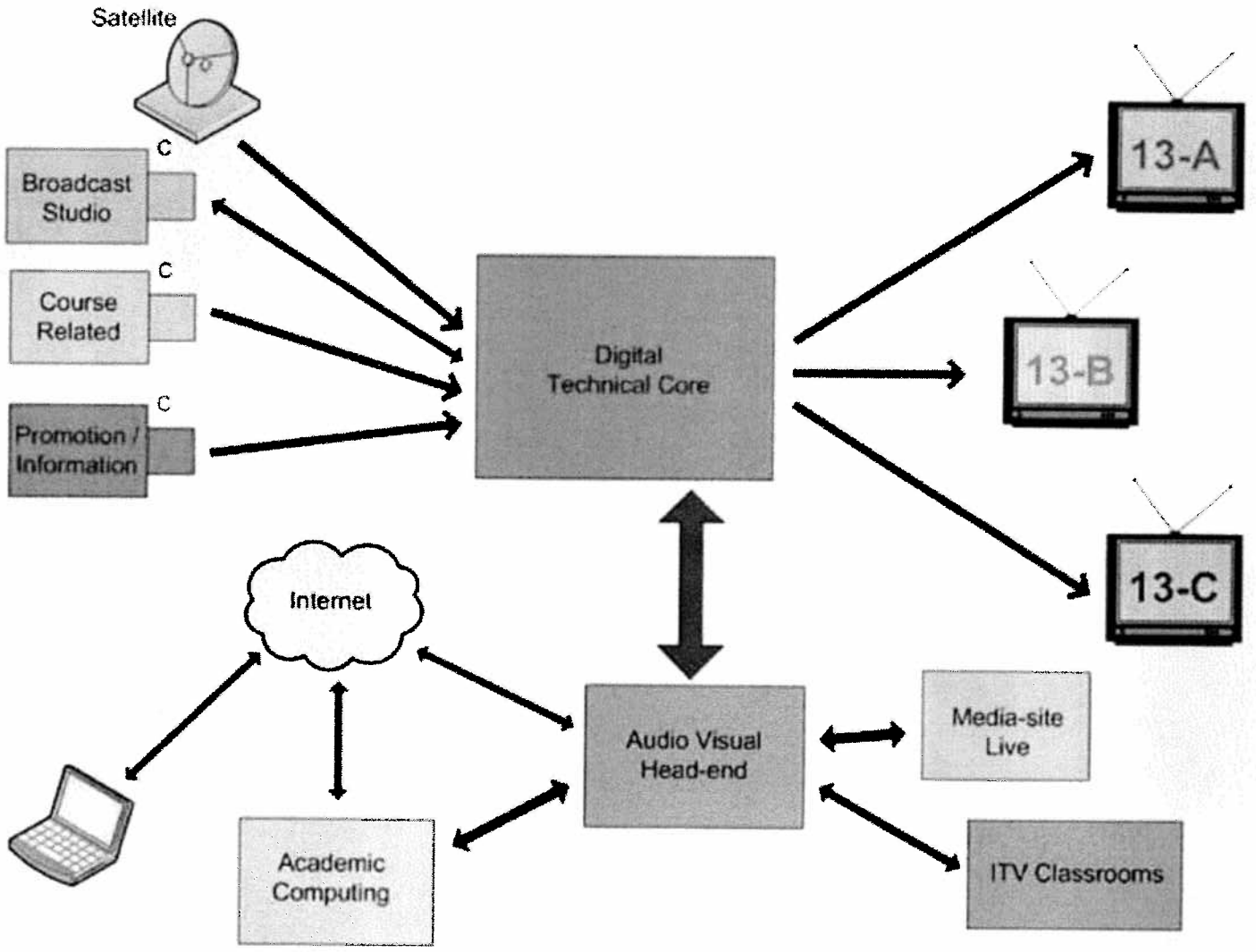
Analog Television



Digital Television



Interactive Television (ITV)

ITV programs:

- 26 Career pathway presentations
- 60 – 80 Virtual field trips each year
- Teacher training
- Inter-district administrative meetings
- International connections with other Universities

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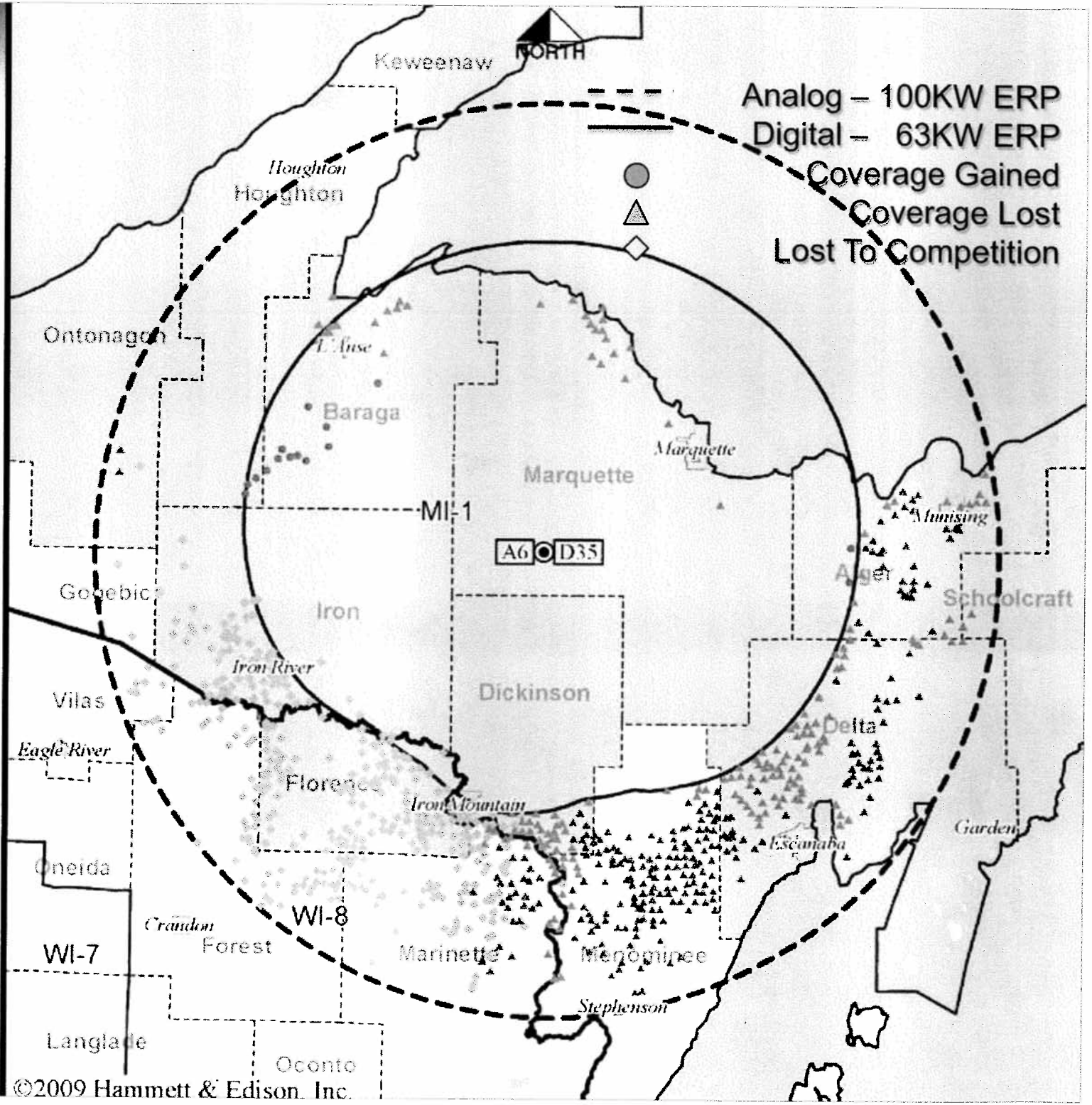
U.P. Broadcast Coverage

WLUC- TV (NBC)



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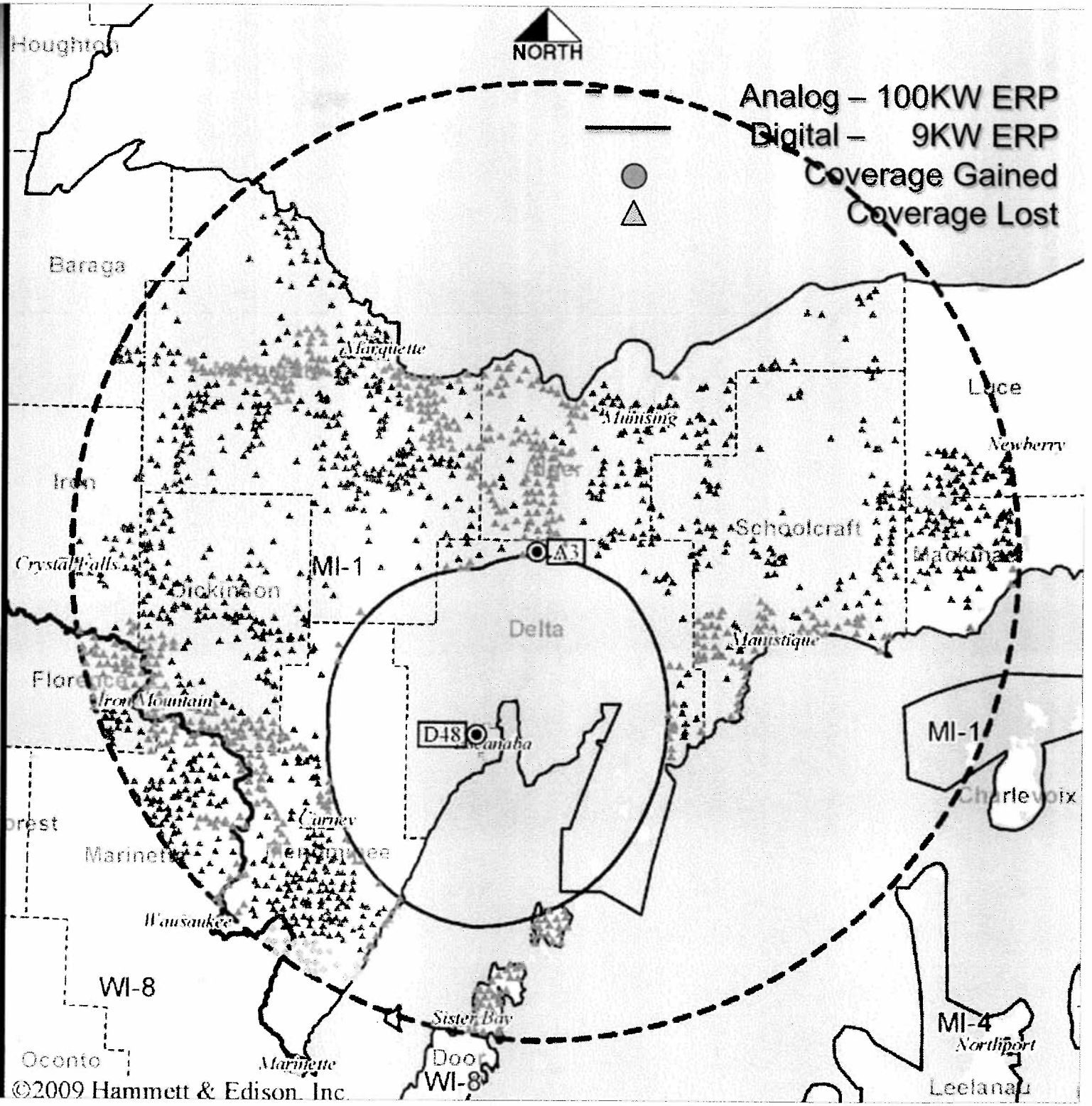
U.P. Broadcast Coverage

WJMN - TV (CBS)



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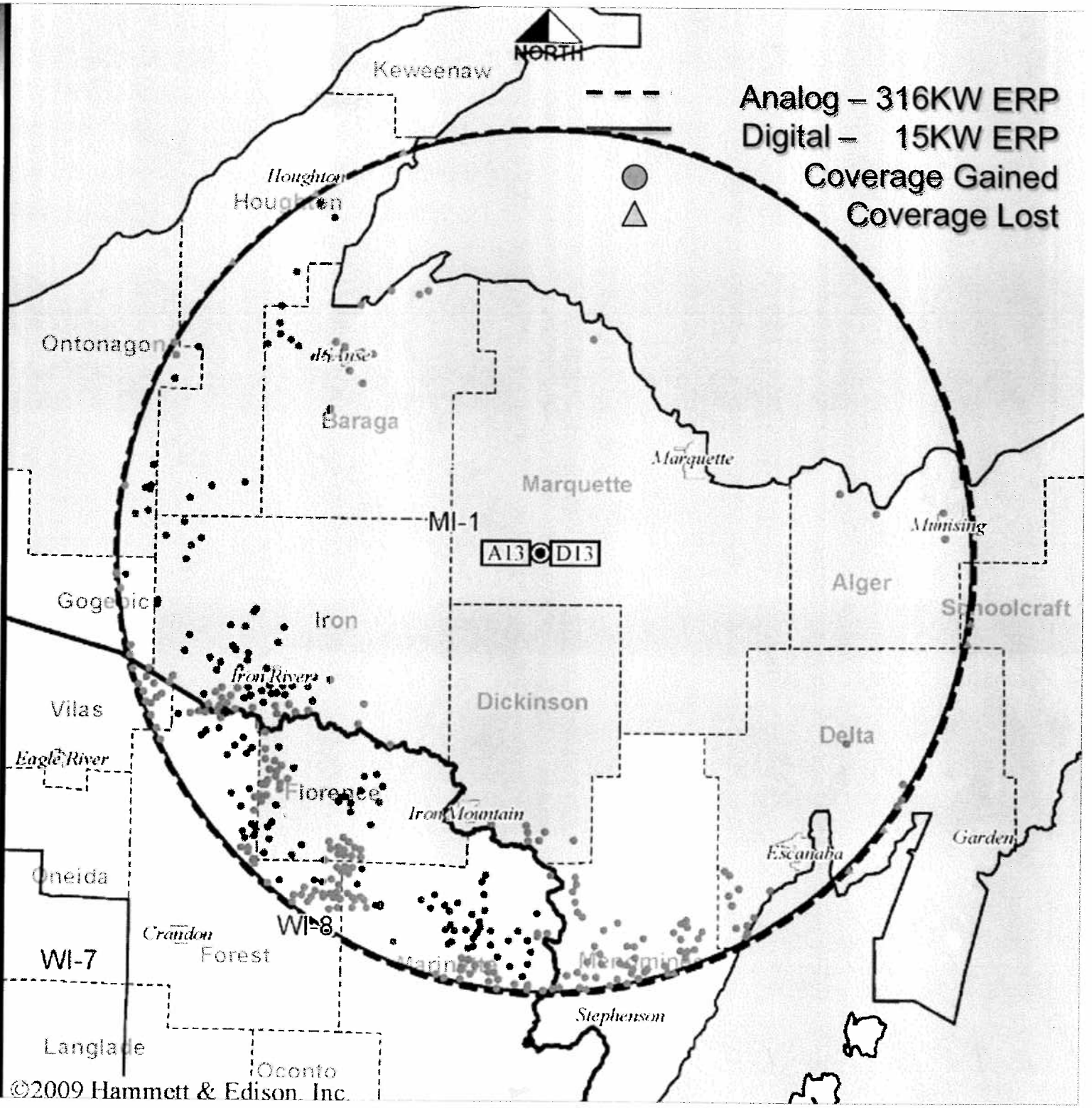
U.P. Broadcast Coverage

WNMU - TV (PBS)



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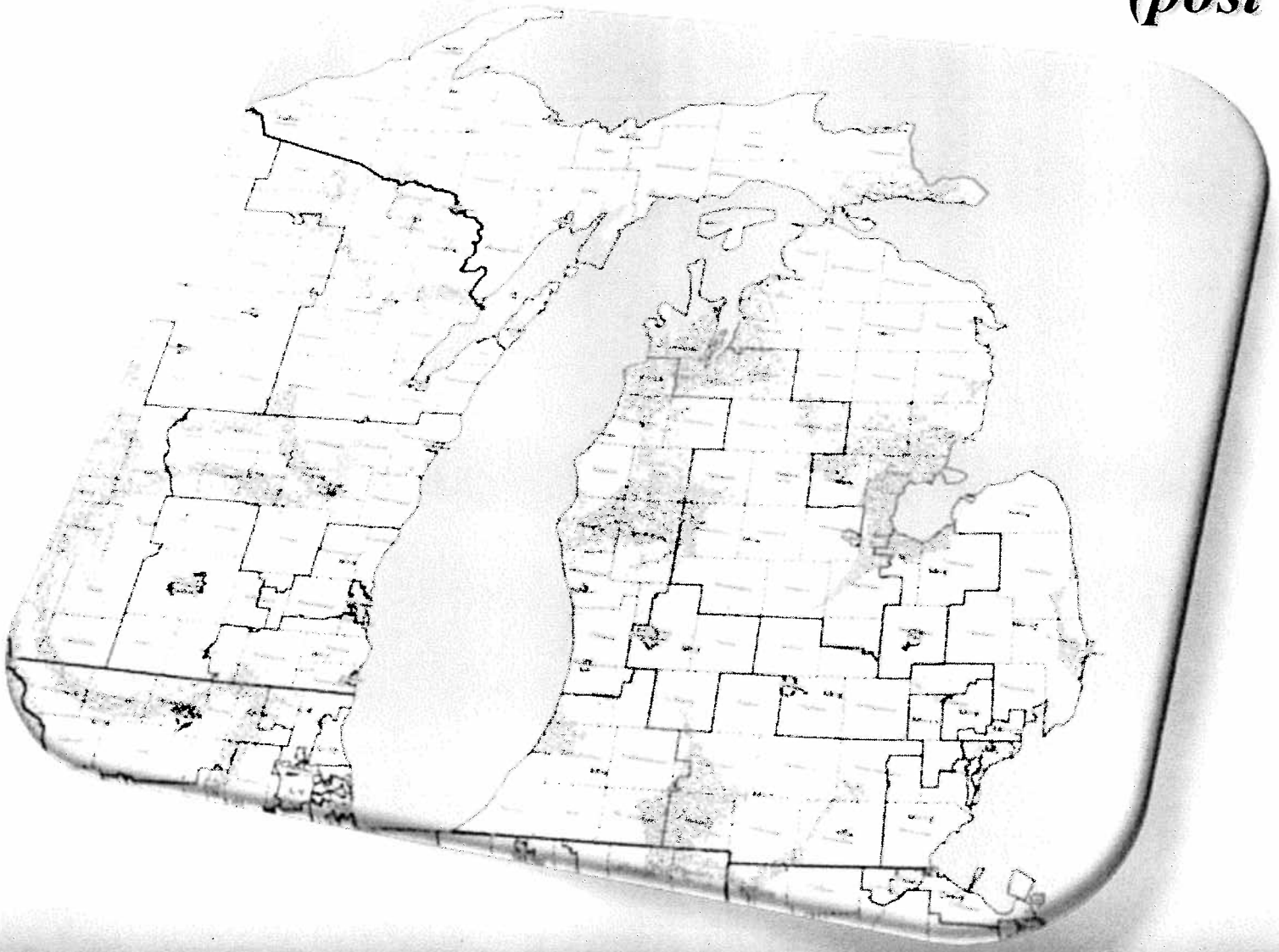
Michigan's PBS Coverage

(post transition)



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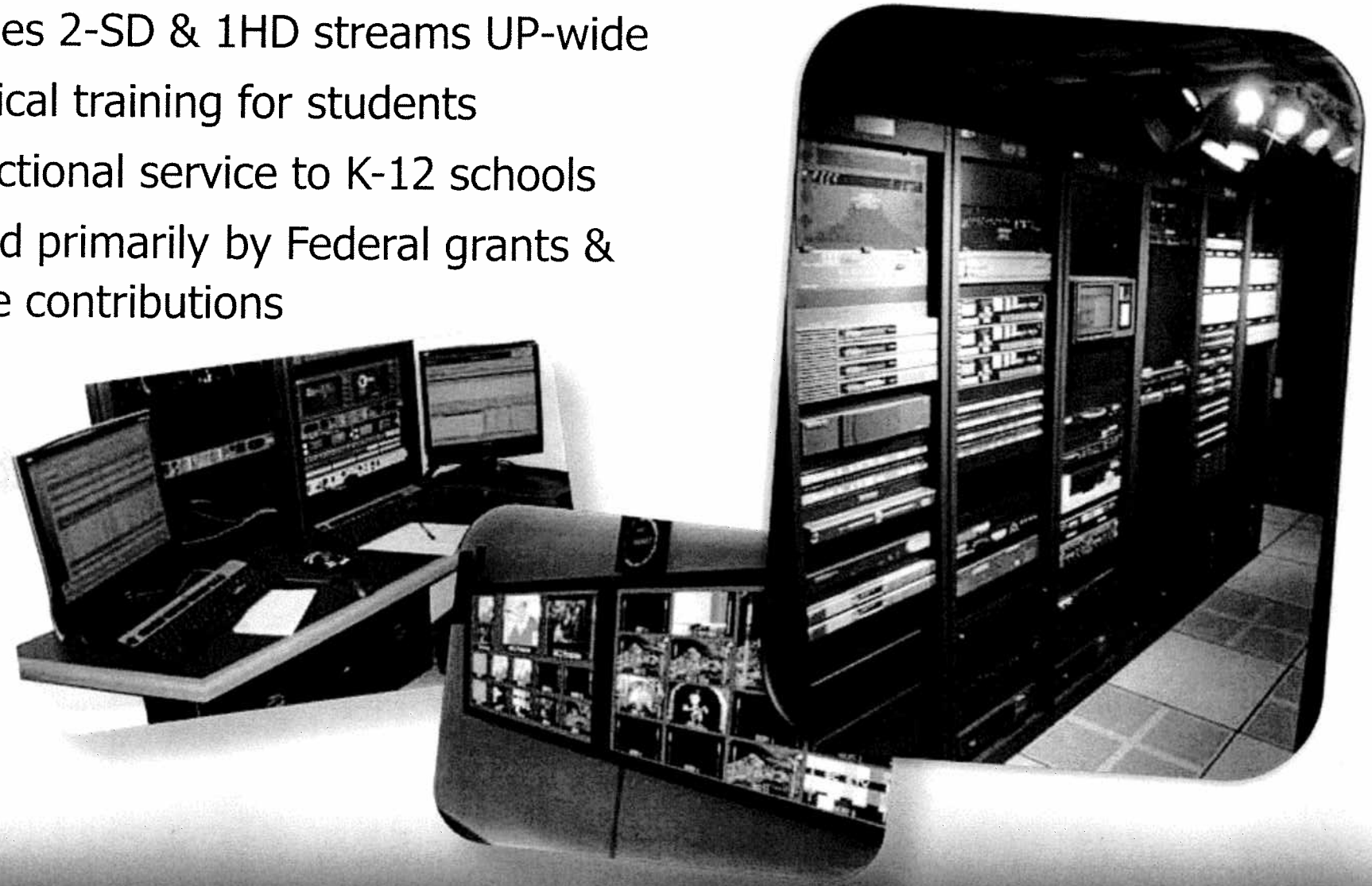
WNMU-TV Technical Core

Facility Summary

- Provides 2-SD & 1HD streams UP-wide
- Technical training for students
- Instructional service to K-12 schools
- Funded primarily by Federal grants & private contributions



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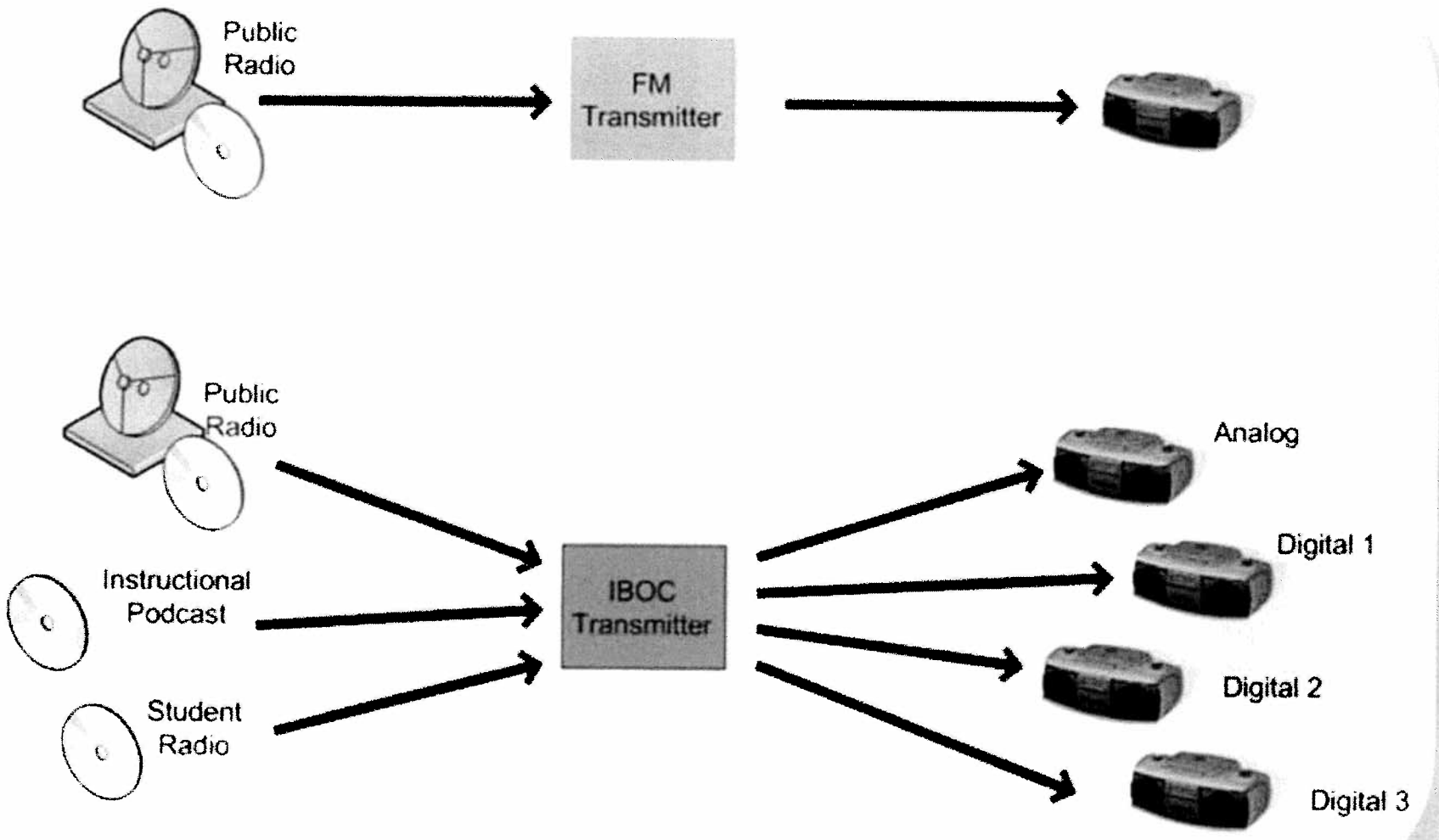
NMU Public Radio



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Future Plans

- FCC approval for additional bandwidth
- Additional collaborative projects with K-12 schools
- Professional development opportunities for teachers
- Local / State "users group" to define collaborative WiMAX projects and potential savings
- University/Corporate test site projects to aid in the development of wireless technology
- New college level curriculum in advanced network engineering

Lessons Learned

- Spectrum is extremely valuable. Michigan's public institutions possess a valuable resource and can use it to the State's advantage.
- Cooperation gets it done… at an affordable price.
- WiMAX technology has the potential expand student access to teaching and learning… especially in rural Michigan.
- Layering wireless and broadcast technologies as appropriate facilitates instructional performance and outcomes.